Remarks and Arguments

Claims 1-33 have been presented for examination. Claims 1, 9 and 17 have been amended. Claims 25-33 have been canceled.

Claims 26-29 have been rejected as dependent claims that omit the number of the claim on which they depend. As claims 26-29 have been canceled, this objection is moot.

Claims 25-33 have been rejected under 35 U.S.C. §101 for being drawn to non-statutory subject matter. Claims 25-33 have been canceled, thereby rendering this rejection moot.

Claims 1-33 have been rejected under 35 U.S.C. §102(b) as anticipated by a Master's thesis entitled "Incremental Mature Garbage Collection", S. Grarup and J. Seligmann, Aarthus University, August 1993 (Grarup). The examiner comments that all of the claimed limitations are disclosed in the reference.

The present invention concerns a method and apparatus for preventing "futile" collection cycles in an incremental garbage collector. A futile collection cycle occurs when a garbage collection cycle completes, but no memory space has been reclaimed and no object have been evacuated from the current collection set. In accordance with the invention, after determining that a futile collection cycle has been entered, one or more younger cars in the oldest train that contain objects referenced from outside the oldest train are identified and included in the current collection set. In addition, cars in the oldest train that are not in the current collection set but are older than any of the added cars must also be scanned for references.

The Grarup reference also discloses a method for preventing futile collection cycles in an incremental garbage collector. However, the disclosed method is considerably different from that of the present invention. As disclosed, in Grarup, whenever a futile collection occurs, one of the external references to objects further down the train is recorded. A reference thus recorded may not be immediately collected, but is used as an additional root when the car that contains the reference is collected. The reference is not discarded until a non-futile collection occurs.

The Grarup reference is discussed in the present specification at page 25, lines 13-20. As noted there, a drawback of the Grarup procedure is that unreachable references (that are garbage) may be retained by the system because they are recorded references. This drawback is also noted in the Grarup reference itself at page 48, section 4.4.5. The differences between the two disclosed methods are recited in the claims. Claim 1 is illustrative. It recites, at lines 5-9, "...identifying a car outside the current collection-set in the oldest train, where the identified car contains an object referenced from outside the oldest train" and "adding the identified car to the current collection to form an augmented collection-set..." The examiner points to Grarup, Page 47, paragraphs 2 and 3. However, claim 1 recites that a **car** is identified and added to the current collection set, whereas Grarup discloses that an **object reference** is identified and stored. A car is a data structure that is associated with a memory region containing objects. Thus, a car and an object reference are not the same or equivalent.

Further, claim 1 recites that the identified car is added to the current collection set. Grarup discloses that the identified object reference is stored. The two actions are not the same. The examiner argues that the object reference is evacuated and, to be evacuated, the object reference must be added to the collection set. However, in Grarup, the stored reference is not added to the current collection set (which is defined in amended claim 1 as the collection set used during the futile collection); instead collection proceeds until the car in which the stored reference resides becomes part of another collection set. Then the object is evacuated. See Grarup, Page 47, paragraphs 3 and 4. As noted in Grarup, the identified object reference cannot be added to the current collection set because of remembered set update restrictions.
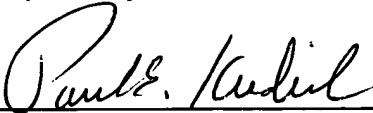
Thus, amended claim 1 patentably distinguishes over the cited reference. Claims 2-8 are dependent on claim 1 and incorporate the limitations thereof. Therefore, they distinguish over the cited reference in the same manner as claim 1.

Claim 9 has been amended in a manner similar to the amendments made to claim 1. Consequently, claim 9 also patentably distinguishes over the cited reference. Claims 10-16 are dependent on claim 9 and incorporate the limitations thereof. Therefore, they distinguish over the cited reference in the same manner as claim 9.

Claim 17 has been amended in a manner similar to the amendments made to claim 1. Consequently, claim 17 also patentably distinguishes over the cited reference. Claims 18-22 are dependent on claim 17 and incorporate the limitations thereof. Therefore, they distinguish over the cited reference in the same manner as claim 17.

In light of the forgoing amendments and remarks, this application is now believed in condition for allowance and a notice of allowance is earnestly solicited. If the examiner has any further questions regarding this amendment, he is invited to call applicants' attorney at the number listed below. The examiner is hereby authorized to charge any fees or direct any payment under 37 C.F.R. §§1.17, 1.16 to Deposit Account number 02-3038.

Respectfully submitted

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